The Andhra Agric. J 64 (4): 912-919, 2017

Stability Studies on Tomato Paste From Blends of Natty and Hybrid Varieties

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ABSTRACT

Tomatoes and Tomato paste are very popular in worldwide owing to their nutritional quality and cost effectiveness. Two Tomato varieties of Natty and Hybrid are used in the preparation of Tomato paste by blending with different ratios for the present investigation. The samples are kept at both ambient and refrigerated conditions. The physico-chemical properties like TSS, acidity, ascorbic acid, pH, consistency and color are analyzed in both the conditions for about 150 days during storage. Simultaneously microbial parameters like TPC, yeast & moulds and coliforms were evaluated for same period of time. The results shows that the parameters like pH, consistency, ascorbic acid, color were gradually decreased, whereas TSS, acidity were increased in all the samples of Tomato paste during the storage in both conditions. However, all samples of Tomato paste kept at ambient and refrigerated conditions were found good after storage period. But it is high cost for maintaining temperature in refrigerated conditions.

Key words*: Ambient conditions, Hybrid, Natty, Refrigerated conditions.Tomato Paste.*

Tomato is one of the most important vegetables worldwide because of its high consumption, year round availability and large content of health related components (Murali et al, 2013). Its utilization as an ingredient in vegetable salads, other dishes and its processing into different products like puree, ketchup and juices are well documented. Tomatoes are an important agricultural commodity worldwide. The tomato fruit is comprised of skin, pericarp, and locular contents. The locular cavities are filled with jelly-like parenchyma cells that surround the seeds. Tomatoes normally contains 5 to 10% dry matter, of which about 75% is soluble, and about 1 to 3% of which consists of skin and seed. Nearly half of the total dry matter is reducing sugars, and about 10% is organic acid, principally citric and malic acids. More than 80% of processed tomatoes are consumed in the form of tomato juice, paste, puree, catsup, sauce, and salsa (Gould, 1992). Tomatoes and tomato-based foods are considered healthy foods for several reasons. They are low in fat and calories, cholesterol free, and a good source of fiber and protein. Tomato is an important herbaceous perennial vegetable. They are a reasonably good source of vitamins and minerals.

It is also very high in moisture and cellulose but low in protein, most of which is in the seed. Tomato paste is manufactured according to the customer requirements. The color is one of the prime most parameter was required by the customer. The hybrid varieties contains high color value and costlier than natty varieties. Many a times industry was manufacturing tomato paste by blending these two varieties. However, the data available was scanty. To study the blending of these two varieties to produce tomato paste is carried out for present investigation.

The objective of the present work is to study the quality parameters that directly decide the price of the Tomato paste are as follows.

1. To estimate the physico-chemical parameters of Tomato paste prepared from blends of two varieties.
2. To analyse the microbial parameters of Tomato paste prepared from blends of different varieties.
3. Study the changes in above parameters of Tomato paste from different blends during ambient and refrigerated storage.

MATERIAL AND METHODS

Fully ripened red commercial variety tomatoes (*Lycopersiconesculentum*) are used in the processing of tomato paste. These are procured from Chittor.

1. Natty: It is local variety and obtained from in and around Chittor district. These tomatoes have a lower TSS range when compared to the hybrid variety.

2. Hybrid (Roma or bangalore tomatoes - Indian hybrid): Roma is a plum tomato popularly used both for canning and production tomato paste because of their slender and firmnature. Roma tomato are also known as Italian tomatoes or Italian plum tomatoes, has an elongated oval, egg or pear shape and comes in red or yellow varieties.

Physico-chemical properties of Tomato paste:

The following physico-chemical properties of Tomato paste namely TSS, ascorbic acid, pH, consistency and color were analyzed for both ambient and refrigerated conditions.

Total soluble solids were determined using Atago Hand Refractometer (0-32%) a drop of tomato juice was used to determine the TSS with the help of refractometer (Ranganna, 2011). The titrable acidity of tomato paste samples are analyzed by titration method and expressed in terms of citric acid (Ranganna, 2011). The ascorbic acid content was determined by 2,6 Dichlorophenol, Indophenol visual titration method (Ranganna, 2011). The pH of tomato paste was measured by using standard method (Ranganna, 2011). Bostwick consistency meter was used for measurement of consistency. (USDA 1971). The measurement of color in Tomato paste samples were measured using Hunter's lab. Color is one of the most appreciable quality traits of tomato products. Color is often used as an indication of quality and freshness for food products, including tomato product for which the perception is "the redder the better". It has become important for tomato processer to be able to evaluate and grade the products based on color.

Microbiological analysis of Tomato paste:

The following parameters like TPC, yeast and mould, coliforms are evaluated in microbial analysis of Tomato pastes (Ranganna, 2011). Pour plate method was used for detection of TPC, yeast & moulds and coliforms. PDA agar is used for yeast & moulds and incubated at 22°C-25°C without inverting the plates. EMB agar was used for coliforms and incubated at 32°C-37°C without inverting the plates.

RESULTS AND DISCUSSION

The chemical compositions of tomato paste prepared from ripen tomatoes and their different ratio during storage was investigated. The following results were obtained from the experiments conducted.

TSS:

The TSS content of all test samples of tomato paste were presented in the **Table 2 & 3**. The result shows that TSS for all the samples of tomato paste were gradually increased during the storage period at ambient and refrigerated conditions. The decrease in TSS was observed in all the samples due to conversion of soluble sugars to acids in both conditions. Increase in TSS during storage may be due to acid hydrolysis of polysaccharides especially gums and pectin (Luh and Woodroof, 1975 & Safdar *et al.,* 2010).

Acidity:

Acidity of tomato paste stored at different temperatures exhibited a gradual increase throughout the storage period of ambient as well as refrigerated conditions. Table (4 & 5) The acidity was increased more in refrigerated conditions as compared to ambient storage.

The decrease in acidity during the storage period was due to oxidation of alcohol and aldehyde during processing and is influenced by storage temperature, higher the temperature greater the increase in acidity (Gould, 1992). However, raise in acidity was more at higher temperature than at lower temperature.

Ascorbic acid:

Ascorbic acid content for Tomato pastes in all samples during ambient and refrigerated conditions were gradually decreased are shown in **Table 6 & 7**. The decrease in Vit C content was due to precursor, glucose. The soluble sugars were also shown in decrease in trend from the above results. Vitamin C is highly sensitive to oxidation and leaching into water-soluble media during storage (Davey, 2000). The losses of ascorbic acid

Fig 1. Varieties of ripen tomatoes.

Sample ratios mentioned below are chosen for incorporating natty variety in paste.

Sample 1 100% Natty
Sample 2 10% Hybrid & 90% Natty
Sample 3 20% Hybrid & 80% Natty
Sample 4 30% Hybrid & 70% Natty

Fully matured & ripened tomatoes

↓

Fruit sorting

↓

Fruit washing (I) & (II)

Destoner ½ & 1/4

1st Pre heating (65°-70°c)

2nd Pre heating (65°-70°c)

1st Pulper 1/8 & 1/48

2nd Pulper 1/8 & 1/48

3rd Pulper 1/8 & 1/48

Aseptic filling (30-35°c)

Fig 2 Flow chart for preparation of Tomato paste

Table 1. Chemical parameters for fully ripen Tomato.

Chemical parameters	Natty	Hybrid
TSS	4.0	4.4
Acidity (%)	0.59	0.53
Colour (a/b)	1.83	1.85
Ascorbic acid (mg/100gm)	12.8	16
pH	4.28	4.22

Table 2. TSS in Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	TSS at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	28.2 ±0.20	28.2±0.40	29.0±0.20	29.2±0.30
30th day	28.3±0.30	28.4±0.10	29.1±0.40	29.3±0.30
60th day	28.4±0.20	28.6±0.30	29.2±0.70	29.4±0.30
90th day	28.6±0.40	28.8±0.70	29.2±0.20	29.5±0.30
120th day	28.8±0.60	29.1±0.30	29.3±0.50	29.6±0.40
150th day	28.9±0.30	29.2±0.20	29.5±0.20	29.7±0.50

Table 3. TSS in Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated condition.

	TSS at Refrigerated Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	28.4±0.30	28.6±0.20	29.0±0.30	29.3±0.40
30th day	28.5±0.30	28.8±0.30	29.2±0.40	29.4±0.30
60th day	28.7±0.40	28.9±0.30	29.2±0.30	29.5±0.20
90th day	28.8±0.50	29.0±0.20	29.3±0.30	29.6±0.40
120th day	29.0±0.20	29.2±0.30	29.5±0.40	29.7±0.30
150th day	29.1±0.30	29.4±0.40	29.6±0.20	29.8±0.20

Table 4. Acidity in Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	Acidity (%) at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	2.20±0.30	2.15±0.60	2.07±0.40	2.21±0.50
30th day	2.29±0.60	2.27±0.50	2.13±0.50	2.29±0.60
60th day	2.38±0.40	2.40±0.70	2.38±0.60	2.51±0.80
90th day	2.40±0.50	2.32±0.40	2.37±0.60	2.59±0.40
120th day	2.41±0.20	2.50±0.50	2.45±0.40	2.58±0.50
150th day	2.58±0.50	2.52±0.30	2.61±0.50	2.92±0.50

Table 5. Acidity in Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

	Acidity (%) at Refrigerated Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	2.20±0.50	2.15±0.40	2.07±0.70	2.21±0.50
30th day	2.39±0.60	2.29±0.50	2.20±0.40	2.31±0.70
60th day	2.50±0.50	2.44±0.40	2.38±0.50	2.47±0.40
90th day	2.53±0.30	2.59±0.60	2.36±0.60	2.52±0.60
120th day	2.59±0.40	2.73±0.60	2.38±0.40	2.56±0.50
150th day	2.70±0.60	2.94±0.50	2.49±0.30	2.86±0.40

Table 6. Ascorbic acid in Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	Ascorbic acid (mg/100gm) at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	59.0±3.6	60.2±2.8	65.8±4.6	74.9±4.2
30th day	55.2±2.9	54.2±4.7	57.6±5.3	54±3.4
60th day	46.2±4.2	42.2±4.7	39.4±3.6	48.2±4.1
90th day	40.2±3.7	39.4±4.4	35.7±3.9	44.9±2.9
120th day	36.8±4.5	35.2±3.7	32.4±4.2	42.6±3.5
150th day	23.2±4.6	33.2±4.3	34.8±3.3	42.7±4.4

Table 7 Ascorbic acid in Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

	Ascorbic acid (mg/100gm) at Refrigerated Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	59±3.3	60.2±4.2	65.8±3.5	74.9±4.3
30th day	52.8±2.9	58.0±2.9	61.2±4.9	68.2±4.5
60th day	47.6±4.3	52.8±3.8	57.4±2.7	61.1±4.2
90th day	45.9±3.9	46.1±3.3	50.3±4.3	57.2±3.8
120th day	42.8±3.7	44.1±4.5	47.4±3.7	59.4±4.7
150th day	42.8±4.7	44.7±3.5.2	49.8±3.5	56.8±4.3

Table 8. pH in Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	pH at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	4.31±0.03	4.42±0.05	4.41±0.04	4.43±0.02
30th day	4.28±0.05	4.36±0.04	4.37±0.02	4.33±0.04
60th day	4.18±0.02	4.27±0.03	4.26±0.02	4.28±0.03
90th day	4.12±0.04	4.18±0.02	4.2±0.03	4.15±0.03
120th day	4.14±0.03	4.18±0.05	4.14±0.03	4.09±0.03
150th day	4.04±0.03	4.11±0.03	4.13±0.05	4.08±0.02

Table 9. pH in Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

	pH at Refrigerated Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	4.31±0.02	4.42±0.04	4.41±0.02	4.43±0.03
30th day	4.28±0.03	4.46±0.04	4.42±0.02	4.35±0.03
60th day	4.23±0.03	4.37±0.03	4.37±0.053	4.27±0.03
90th day	4.17±0.04	4.25±0.03	4.31±0.03	4.19±0.02
120th day	4.18±0.04	4.21±0.04	4.27±0.02	4.15±0.05
150th day	4.15±0.03	4.17±0.05	4.21±0.05	4.15±0.03

Table 10. Consistency in Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	Consistency (cm/30 sec) at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	3.8±3.0	3.6±4.0	4.6±4.0	5.9±4.0
30th day	3.6±4.0	3.7±3.0	4.9±3.0	5.7±3.0
60th day	3.6±2.0	2.6±4.0	4.4±3.0	4.4±2.0
90th day	3.4±5.0	2.7±3.0	3.4±2.0	5.2±2.0
120th day	3.0±3.0	2.4±2.0	3.0±3.0	5.6±3.0
150th day	2.0±1.0	1.8±3.0	3.0±2.0	5.0±4.0

Table 11. Consistency in Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

	Consistency (cm/30 sec) at Refrigerated Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	3.8±3.0	3.6±3.0	4.6±3.0	5.9±4.0
30th day	3.8±4.0	3.0±4.0	3.7±4.0	5.7±25.0
60th day	3.2±2.0	2.7±5.0	3.5±2.0	5.2±5.0
90th day	2.8±4.0	2.3±3.0	3.3±5.0	5.0±3.0
120th day	2.5±5.0	2.1±4.0	3.4±3.0	5.2±5.0
150th day	2.5±3.0	2.0±3.0	3.0±4.0	4.5±4.0

Table 12. Changes in color of Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

	Color (a/b value) at Ambient Conditions			
Storage period	Sample1	Sample2	Sample 3	Sample 4
0th day	1.63± 0.5	1.62± 0.3	1.75± 0.7	1.89± 0.5
30th day	1.62± 0.4	1.61± 0.2	1.74± 0.9	1.85± 0.4
60th day	1.62± 0.2	1.60± 0.9	1.74± 0.5	1.80± 0.6
90th day	1.61± 0.4	1.60± 0.6	1.73± 0.3	1.78± 0.3
120th day	1.60± 0.7	1.59± 0.3	1.72± 0.6	1.76± 0.4
150th day	1.59± 0.5	1.58± 0.7	1.72± 0.3	1.73± 0.5

Table 13. Changes in color of Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

Storage period	Color (a/b value) at Refrigerated Conditions			
	Sample1	Sample2	Sample 3	Sample 4
0th day	1.63± 0.4	1.62± 0.5	1.75± 0.3	1.89± 0.5
30th day	1.62± 0.7	1.62± 0.3	1.74± 0.9	1.86± 0.3
60th day	1.62± 0.4	1.61± 0.8	1.74± 0.6	1.83± 0.3
90th day	1.61± 0.6	1.61± 0.3	1.74± 0.2	1.82± 0.5
120th day	1.61± 0.4	1.60± 0.6	1.73± 0.9	1.78± 0.4
150th day	1.60± 0.5	1.59± 0.3	1.73± 0.4	1.75± 0.5

Table 14. Changes in color (L value) of Tomato paste with different ratios of Natty and hybrid varieties when stored at ambient conditions.

Storage period	Color (L value) at Ambient Conditions			
	Sample1	Sample2	Sample 3	Sample 4
0th day	29.68±0.18	30.29±0.14	30.42±0.20	30.92±0.15
30th day	29.56±0.11	30.01±0.13	30.19±0.19	30.50±0.24
60th day	28.52±0.19	29.57±0.17	29.74±0.11	30.21±0.15
90th day	28.22±0.15	29.18±0.16	29.56±0.15	30.02±0.17
120th day	27.22±0.17	28.82±0.14	29.11±0.13	29.79±0.18
150th day	27.02±0.16	28.58±0.21	28.84±0.22	29.36±0.11

Table 15. Changes in color (L value) of Tomato paste with different ratios of Natty and hybrid varieties when stored at refrigerated conditions.

Storage period	Color (L value) at Refrigerated Conditions			
	Sample1	Sample2	Sample 3	Sample 4
0th day	29.68±0.21	30.29±0.14	30.42±0.18	30.92±0.12
30th day	29.54±0.16	30.07±0.06	30.28±0.13	30.72±0.16
60th day	29.05±0.18	29.69±0.15	30.18±0.17	30.47±0.11
90th day	28.5±0.19	29.17±0.18	29.42±0.17	30.14±0.14
120th day	27.58±0.21	29.05±0.11	29.35±0.11	29.87±0.15
150th day	27.52±0.17	29.01±0.20	29.22±0.17	29.45±0.12

is probably attributable to oxidation of ascorbic acid to dehydroascorbic acid followed by hydrolysis of the latter to 2,3-diketogluconic acid (Dewanto *et al.*, 2002 & George *et al.*, 2010).

pH:

As regards pH of tomato paste held at different temperatures, a decreasing trend was observed during the storage period. Table (8&9) The temperature influences the decrease in pH. Change in pH is directly related to change in acidity of samples. There is an inverse relationship between pH and titrable acidity.

Consistency:

Consistency for Tomato paste in all samples during ambient and refrigerated conditions were gradually decreased is represented in **Table 10 & 11**. The consistency loss in tomato paste is that the high osmotic and ionic strength in the paste causes changes in the polymeric materials in juice particles, altering the interactions between these particles and changing rheological properties of the juice when reconstituted with water (Gordon 2010).

Color:

Color is a very important quality factor in processed tomato paste. The color of all the test

samples of tomato paste samples with L, a, b values were presented in **Table 12 to 15**. From the present experiment, it was observed that the color of all the samples of tomato samples were changed during storage periods and all samples found good.

Color (a/b value):

Microbial analysis of Tomato paste:

The samples of Tomato paste kept at ambient and refrigerated conditions were evaluated for TPC, yeast & moulds and coliforms were not found during storage period.

According to customer specifications, Tomato paste was processed. The color is one of the most important parameter required for customer. The highest color value of Hybrid varieties are costly than the Natty varieties. The blends of different ratios of above mentioned varieties along with the color and other parameters that influence the quality of final Tomato paste during the storage periods are studied.

Two Tomato varieties of Natty and Hybrid are used in the preparation of Tomato paste by blending with different ratios. The samples are studied at both ambient and refrigerated conditions. The physico-chemical properties like TSS, acidity, ascorbic acid, pH, consistency and color are analyzed in both the conditions for about 150 days during storage. Simultaneously microbial parameters like TPC, yeast & moulds, coliforms were evaluated for same period of time.

The results shows that the parameters like TSS, pH, consistency, ascorbic acid was gradually increased, whereas acidity was increased in all the samples of Tomato paste during the storage in both conditions. However, the all samples of Tomato paste kept at ambient and refrigerated conditions were found good after storage period. The samples were stored at refrigerated conditions having best keeping quality when compared to ambient conditions. But it is high cost for maintaining temperature in refrigerated conditions.

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(Received on 23.03.2017 and revised on 02.06.2017)